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PATENT SPECIFICATION

Inventor: LESLIE JOHN MONCRIEF.

758,036

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COMPLETE SPECIFICATION

Embossing Thermoplastic Sheet

We, BRITISH CELANESE LIMITED, of Celanese House, 22/23, Hanover Square, London, W.1., a Company incorporated in accordance with the laws of Great Britain, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement :—

This invention relates to embossing, and provides a new method of embossing thermoplastic sheet material.

The present invention provides a process for modifying the surface of a sheet of thermoplastic material, which comprises supporting said sheet by its edges so that it faces and is spaced apart from the patterned or irregular surface of a suitably supported air-permeable fibrous web, heating said sheet to a temperature at which it is plastic, rapidly withdrawing air from the space between the sheet and the web so as suddenly to draw the sheet in the plastic condition into close overall contact with the surface of the web, and subsequently stripping the sheet, at a temperature at which it is no longer plastic, from the web.

The heating is preferably effected, immediately before sucking the sheet into contact with the pattern, by exposure to a source of radiant heat.

For carrying out the embossing, the fibrous web may, for instance, be laid flat on a flat sheet of gauze, which, in turn, rests on the perforated false bottom of an open-mouthed pressure-vessel (referred to below as the "vacuum-box"), and means may be provided for rapidly evacuating the space within the vacuum-box below the false bottom. The thermoplastic sheet may then be clamped to the edge of the mouth of the vacuum-box and raised to the necessary temperature by means of a radiant heater, which can conveniently be arranged to swing into and out of position above the mouth of the vacuum-box. When the sheet has become plastic the heating member is swung out of position and the embossing is effected by opening a quick-acting valve connecting the space below the false bottom in the vacuum-box with suction means preferably embodying a large evacuated container connected with an electrically-driven vacuum-pump. The embossed sheet rapidly cools to a temperature at which it is no longer plastic. It is then unclamped, and separated from the fibrous web, after which the cycle of operations can be repeated on a fresh sheet of the thermoplastic. The whole operation can be carried out with great rapidity. By a suitable choice of fibrous web, e.g. by using a patterned lace fabric, most attractive designs can be embossed on the sheet. One of the many advantages of the process over embossing by means of engraved rollers is that it enables sheets to be obtained which are flat and have no tendency to curvature.

In the accompanying diagrammatic drawings :—

Figure 1 shows in part sectional elevation a suitable arrangement of apparatus for carrying out the embossing; and

Figure 2 is a plan view representing a product according to the invention.

Referring now to Figure 1, a wide open-mouthed vessel 10 (the "vacuum-box"), constructed to withstand atmospheric pressure when evacuated, is provided with a perforated false bottom 11 (the "platform"), formed of a rigid steel plate perforated with holes 1/16" diameter at ½" centres. This plate rests on wooden blocks 12, which in turn rest on the bottom 13 of the vacuum-box 10.

Covering the upper surface of the platform 11 is a sheet of fine wire gauze 14. On top of this is laid the pattern 15, a fibrous web which may advantageously consist of a sheet of lace fabric. Immediately above

the open mouth of the vacuum-box is a clamping frame 16, provided with rapidly operable toggle clamping means (not shown), by the operation of which a sheet 17 of thermoplastic material can be clamped between the frame 16 and the upper edge 18 of the vacuum-box. Above the clamping frame is a blanket-type radiant heater 19, by means of which the thermoplastic sheet 17, while clamped across the mouth of the vacuum-box, can be rapidly heated to a temperature at which it is plastic. This heating element runs on rails (not shown) extending above the vacuum-box and to one side thereof, so that once the sheet has been heated to a sufficiently high temperature, the heat element may be pushed along the rails to one side of the vacuum-box.

A large-bore suction pipe 20 connects the space 21 in the vacuum-box beneath the platform 11 via a quick-opening throttle valve 22 with a vacuum tank (not shown).

In operation the sheet 18 is clamped in position as described, the heater is pulled along its rails until it is directly over the mouth of the vacuum-box, the valve 22 being closed, but the vacuum tank already evacuated. When the thermoplastic sheet 17 has become quite plastic (which can commonly be ascertained by noting that wrinkles at first present in the sheet have disappeared) the heating element 19 is pushed to one side and simultaneously the valve 22 is opened fully. This causes rapid evacuation of the space 21, in consequence of which the plastic sheet 17 is pulled suddenly downwards into contact with the pattern 15. (The whole of the sheet makes contact with the pattern except for a marginal portion, part of which is held between the clamping-frame 16 and the edge 18, and the remainder of which extends from the edge 18 down the sides 23 of the vacuum-box). The thermoplastic sheet now cools rapidly to a temperature at which it is no longer plastic, and at this temperature it is stripped from the pattern. The cooling may, if desired, be assisted by blowing cold air on to the surface of the sheet, and the stripping can be assisted by introducing positive air pressure into the space 21 through a by-pass (not shown) to the pipe 20, but neither of these refinements is in general necessary.

Referring now to Figure 2, this shows in plan a part of the thermoplastic sheet embossed with the pattern of the lace.

The fibrous web employed must be of such material that it can readily be separated from the thermoplastic sheet after the embossing. With thermoplastic sheet of plasticized cellulose acetate we have obtained excellent results with fabrics of cellulose, e.g. of cotton or regenerated cellulose. Other natural fibres and artificial non-thermoplastic fibres, e.g. polyacrylonitrile, polytetrafluorethylene, glass and asbestos can also constitute, or be present in, the fabric. Fibrous webs made of or containing thermoplastic polymers can be used provided the polymer does not become soft or sticky at the temperature to which it is subjected by contact with the hot thermoplastic sheet. Stripping may be facilitated by the previous application to the fibrous web of a parting agent, e.g. a solution or dispersion of a suitable organo-silicon polymer.

As indicated above, the most pleasing effects have been obtained with fibrous web consisting of lace fabric, either hand-made or machine-made. Other kinds of fabrics, whether woven, knitted, netted, or otherwise made, can be used. For obtaining a matt effect on the sheet material, fabrics comprising staple fibre yarns and having a surface presenting an array of fibres projecting from the yarns to which they belong and spread over said surface so as to conceal the fabric structure below, e.g. surgical lint, have been found particularly suitable. The fibrous web need not be a textile fabric. Thus, for example, perforated and/or embossed paper webs, especially webs simulating lace, have been used successfully.

The thermoplastic sheet material may be transparent, colourless and plain; or may be transparent, coloured and plain; or may be opaque; and may, if desired, be printed or decorated before being embossed. A very suitable material for the thermoplastic sheet is cellulose acetate of acetyl value about 54%, plasticised with about 30% of its weight of a mixture of dimethyl phthalate with triphenyl phosphate in relative proportions of about 5:1. Other plasticisers than those specified may be employed, for example diethyl phthalate, dibutyl phthalate, triacetin, dimethoxyethyl phthalate, methyl phthalyl ethyl glycolate, ethyl phthalyl ethyl glycolate, dibutyl tartrate, acetyl triethyl citrate and trichlorethyl phosphate. The acetyl content of the cellulose acetate preferably lies between 53 and 55%, calculated as acetic acid, but may be somewhat less, e.g. between 52 and 53, or may be above 55%, e.g. 56 to 58%, provided it be suitably plasticised. Other thermoplastics that can be employed instead of cellulose acetate (together with suitable plasticisers where necessary) include other thermoplastic cellulose derivatives such as cellulose propionate, cellulose acetate-propionate, cellulose acetate-butyrate, ethyl cellulose and benzyl cellulose; thermoplastic polyvinyl compounds, such as polystyrene, and copolymers of vinyl chloride with a minor proportion of vinyl acetate, of vinylidene chloride with vinyl chloride, and of vinyl chloride or vinylidene chloride with methacrylonitrile; thermoplastic polymers of

acrylic acid derivatives, for example polyethyl acrylate and polymethyl methacrylate; and rubber hydrochloride.

Preferably the sheet has a basis of a plasticised cellulose ester of a paraffinic monocarboxylic acid containing two to four carbon atoms in the molecule.

The following examples illustrate the invention :—

Example 1

On the perforated false bottom of a vacuum-box of the kind referred to above was laid a square sheet of machine-made lace having a floral pattern. A thermoplastic sheet of thickness 7 mils and of the following composition :—

76 parts of cellulose acetate of acetyl value 54%;
20 parts of dimethyl phthalate;
4 parts of triphenyl phosphate;

was clamped round its edges across the mouth of the vacuum-box so as to make an airtight seal therewith. The radiant heater was brought into position above the clamped sheet, which was heated thereby until it became quite plastic. (A visual indication of this state was the disappearance of minute wrinkles from the surface of the sheet, which occurred after about 10 seconds). The valve to the vacuum-tank was then quickly opened, the heating element being at the same time moved away. The sheet was immediately sucked down on to the lace pattern. The assembly was then unclamped and the embossed sheet separated from the pattern.

In a similar way a paper lace can be used as pattern.

Example 2

The process was carried out as in Example 1, but using as the pattern, instead of the lace, a square of surgical lint (a coarsely woven plain cotton fabric brushed on one side). The lint was used with its fluffy (brushed) side uppermost and imparted a pleasant matt effect to the sheet.

Interesting effects can also be obtained by using in the same way crepe fabrics, velvets and other pile fabrics, satins, fabrics (including knitted and woven fabrics) containing slub yarns or other fancy yarns, felted fabrics, and bats, rovings and other fibrous sheets.

What I claim is :—

1. Process for modifying the surface of a sheet of thermoplastic material, which comprises supporting said sheet by its edges so that it faces and is spaced apart from the patterned or irregular surface of a suitably supported air-permeable fibrous web, heating said sheet to a temperature at which it is plastic, rapidly withdrawing air from the space between the sheet and the web so as suddenly to draw the sheet in the plastic condition into close overall contact with the surface of the web, and subsequently stripping the sheet, at a temperature at which it is no longer plastic, from the web.

2. Process for modifying the surface of a sheet of thermoplastic material, which comprises clamping said sheet by its edges to the open mouth of a chamber so that it faces the patterned or irregular surface of an air-permeable fibrous web supported on a perforated partition within and extending across said chamber, heating the sheet by radiant heat to a temperature at which it is plastic, rapidly evacuating the space between the sheet and the web through said perforations so as to draw the sheet in the plastic condition suddenly into close overall contact with the irregular surface of the web, and subsequently stripping the sheet at a temperature at which it is no longer plastic from the web.

3. Process according to Claim 2 wherein the web is a textile fabric of non-thermoplastic material.

4. Process according to Claim 3, wherein the web is a fabric comprising staple fibre yarns and having a surface presenting an array of fibres projecting from the yarns to which they belong and spread over said surface so as to conceal the fabric structure below, and, by drawing the plastic sheet into contact with this surface of the fabric, a matt effect is imparted to that surface of the sheet that makes contact with the fabric.

5. Process according to Claim 3, wherein the web is a fabric of patterned open-work structure.

6. Process according to Claim 1 or 2, wherein the web is a paper lace.

7. Process according to any of Claims 1 to 6, wherein the thermoplastic sheet has a basis of a plasticized organic substitution derivative of cellulose.

8. Process according to any of Claims 1 to 6, wherein the thermoplastic sheet has a basis of a plasticized cellulose ester of a paraffinic monocarboxylic acid containing two to four carbon atoms in the molecule.

9. Process according to any of Claims 1 to 6, wherein the thermoplastic sheet has a basis of plasticized cellulose acetate.

10. Process for modifying the surface of a sheet of thermoplastic material substantially as hereinbefore described.

11. Process for modifying the surface of a sheet of thermoplastic material substantially as described in Example 1 or 2.

12. A sheet of thermoplastic material having a surface that has been modified by a process claimed in any of Claims 1 to 11.

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PROVISIONAL SPECIFICATION

Embossing Thermoplastic Sheet

We, BRITISH CELANESE LIMITED, of Celanese House, 22/23, Hanover Square, London, W.1, a Company incorporated in accordance with the laws of Great Britain, do hereby declare this invention to be described in the following statement :—

This invention relates to embossing, and provides a new method of embossing thermoplastic sheet material.

I have found that excellent embossed effects can be obtained on thermoplastic sheet material, e.g. material of plasticized cellulose acetate of thickness between 2 and 10 mils, by urging the material in a temporarily softened condition, by applying fluid pressure, into contact with a suitably supported fabric, e.g. a lace fabric of a material from which the embossed sheet can readily be separated after the embossing process.

Preferably the fluid pressure is atmospheric pressure, caused to operate on one side of the softened sheet by applying suction to the other side of said sheet through the fabric and through pores, interstices or perforations in the support therefor. Alternatively, or in addition, fluid pressure, e.g. superatmospheric air pressure or steam pressure, may be applied to that side of the sheet which is not to make contact with the fabric. The softening is preferably effected by heating the sheet, immediately before subjecting it to the fluid pressure, to a temperature at which it is quite limp. Thus, the embossing may be effected by stretching out the sheet in a position in which it faces the fabric against which it is to be urged, the said fabric being extended and suitably supported against movement under the influence of the pressure to be applied, by a rigid perforate support, clamping the sheet by its edges in said position, raising it to the appropriate temperature by exposure to a source of radiant heat, and then evacuating the space between the sheet and the perforate support so that the sheet is pulled into contact with the fabric.

For carrying out the embossing the fabric may, for instance, be laid flat on a flat sheet of gauze, which, in turn, rests on the perforated false bottom of an open-mouthed pressure-vessel (referred to below as the "vacuum-box"), and means may be provided for rapidly evacuating the space within the vacuum-box below the false bottom. The thermoplastic sheet may then be clamped to the edge of the mouth of the vacuum-box and raised to the necessary temperature by means of a radiant heater, which can conveniently be arranged to swing into and out of position above the mouth of the vacuum-box. When the sheet has become limp the heating member is swung out of position and the embossing is effected by opening a quick-acting valve connecting the space below the false bottom in the vacuum box with suction means preferably embodying a large evacuated container connected with an electrically-driven vacuum-pump. The embossed fabric rapidly cools to a temperature at which it is no longer plastic. It is then unclamped, and separated from the fabric, after which the cycle of operations can be repeated on a fresh sheet of the thermoplastic. The whole operation can be carried out with great rapidity. By a suitable choice of fabric, e.g. by using a patterned lace fabric, most attractive designs can be embossed on the sheet. One of the many advantages of the process over embossing by means of engraved rollers is that it enables sheets to be obtained which are flat and have no tendency to curvature.

For a more detailed description of apparatus suitable for carrying out the invention, I would refer to the Provisional Specification of my Application No. 23827/53, wherein a vacuum-box and its ancillary equipment is described and illustrated. Referring to the drawing filed with that Application, the apparatus may be exactly as shown, except that: the porous backing-sheet 11 is replaced by a wire gauze, or omitted; the objects 10 are omitted; and the adhesive layer 12 is omitted, and replaced by the fabric which is to serve as the pattern.

As indicated above, the fabric employed must be of such material that it can readily be separated from the thermoplastic sheet after the embossing. With thermoplastic sheet of plasticized cellulose acetate we have obtained excellent results with fabrics of cellulose, e.g. of cotton or regenerated cellulose. Other natural fibres and artificial non-thermoplastic fibres, e.g. polyacrylonitrile, glass and asbestos can also constitute, or be present in, the fabric. Thermoplastic fibres, e.g. cellulose esters and ethers, thermoplastic polymers (including copolymers) of vinyl and vinylidene compounds, and thermoplastic condensation polymers such as nylon and polyethylene terephthalate, are in general less suitable, although, provided that the fibre is not one that adheres firmly to the thermoplastic material of the sheet, the use of fabrics containing thermoplastic fibre is not excluded.

As indicated above, the most pleasing effects have been obtained with lace fabrics, either hand-made or machine-made. Other

kinds of fabrics, however, whether woven, knitted, netted, or otherwise made, can be used.

The thermoplastic sheet material may be transparent, colourless and plain; or may be transparent, coloured and plain; or may be opaque; and may, if desired, be printed or decorated before being embossed. The thermoplastic sheet materials referred to in Specification No. 23827/53 are generally suitable, and reference to that Specification is made for examples of suitable sheet material.

The following examples illustrate the invention :—

Example 1

On the perforated false bottom of a vacuum-box of the kind referred to above was laid a square sheet of machine-made lace having a floral pattern. A thermoplastic sheet of thickness 7 mils and of the following composition :

76 parts of cellulose acetate of acetyl value 54%;
20 parts of dimethyl phthalate;
4 parts of triphenyl phosphate;

was clamped round its edges across the mouth of the vacuum-box so as to make an airtight seal therewith. The radiant heater was brought into position above the clamped sheet, which was heated thereby until it was seen to become quite limp, which occurred after about 10 seconds. The valve to the vacuum-tank was then quickly opened, the heating element being at the same time moved away. The sheet was immediately sucked down on to the lace pattern. The assembly was then unclamped and the embossed sheet separated from the pattern.

Example 2

The process was carried out as in Example 1, but using as the pattern, instead of the lace, a square of surgical lint (a coarsely plain woven cotton fabric brushed on one side). The lint was used with its fluffy (brushed) side uppermost and imparted a pleasant matt effect to the sheet.

Interesting effects can also be obtained by using in the same way crepe fabrics, velvets and other pile fabrics, satins, fabrics (including knitted and woven fabrics) containing slub yarns or other fancy yarns, felted fabrics, and bats, rovings and other fibrous sheets.

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758,036 COMPLETE SPECIFICATION
1 SHEET

This drawing is a reproduction of the Original on a reduced scale.

FIG. 1

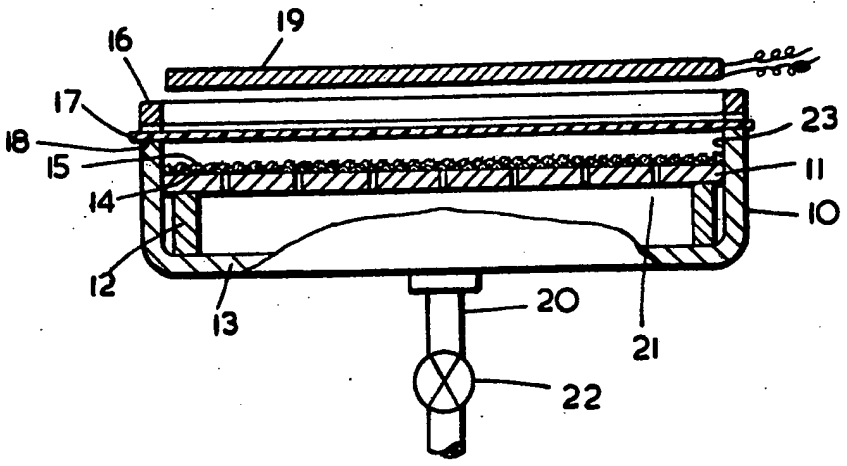

FIG. 2